1986 | ase Management Guide for Commercial Vegetable Growers

THE SUCCESSFUL CONTROL OF VEGETABLE DISEASES requires an integrated program that includes the use of resistant varieties, disease certification programs, crop rotation, balanced soil fertility, weed and insect control, and proper crop culture as well as the selective application of fungicides, bactericides, or nematicides. Economical control depends on establishing an overall disease management system for the entire farm. Keeping careful records of the crops that have been planted, the problems encountered, and the pesticides used is important.

The information in this circular is updated annually. The grower should also consult the current versions of Circular 897, *Insect Pest Management Guide: Commerical Vegetable Crops and Greenhouse Vegetables,* and Circular 907, *Weed Management Guide for Commercial Vegetable Growers,* as well as Circular 1174, *Vegetable Varieties for Commercial Growers,* which contains information on disease resistance. Those circulars are revised each year.

Because many disease problems originate with seeds or transplants, growers should follow the seed treatment recommendations given in this circular or be sure to obtain planting material that is certified free of disease.

This publication presents the vegetable fungicide tolerances and application intervals for various crops as approved by the Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency (EPA) as of October 1, 1985. The tables on the next two pages give the number of days between the last application at the normal rate and the harvest as well as other restrictions that will keep residues within the tolerances set by the FDA.

The listing of a chemical as approved for use on a particular crop does not mean that the Illinois Cooperative Extension Service or Agricultural Experiment Station recommends the use of the chemical for that crop. Our specific recommendations for disease control are given in the table entitled "Condensed Recommendations on Disease Management . . ."

In some instances a tolerance has been set but a definite interval has not been established. The absence of an interval for a particular crop in the listings does not necessarily mean that the fungicide may not be used on that crop. To ensure that the crop produced does not exceed the tolerance, the use of the fungicide would require a restriction such as "do not apply after first blooms appear" or "do not apply after edible parts form." This information appears on the product label.

In a few cases the interval and dosage have been established but the allowable residue concentration has not been determined. Again, this does not mean that the fungicide may not be used on the crops for which it is labeled. It does mean, however, that until the tolerance is established it must be considered as zero. These cases are reviewed each year, and some are cancelled when the chemical manufacturer supplies the EPA with additional data.

Growers must follow a program of disease control that will assure that the vegetables produced do not contain excessive fungicide residues. Vegetables marketed with residues exceeding the FDA tolerances may be injurious to consumers, may be confiscated, and may cause the grower to be brought to court.

Growers have nothing to fear from the law as long as they use fungicides and other pesticides according to the current label and only on the crops specified, in the amounts specified, and at the time specified. The prudent grower keeps a record of the products and trade names used, the percentage of active ingredients, dilutions, rates of application per acre, and dates of application. The record sheet at the end of this circular provides a convenient place to record such information.

This circular is revised each year. Be sure you are using the most recent copy.

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UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN COLLEGE OF AGRICULTURE COOPERATIVE EXTENSION SERVICE

Urbana, Illinois Circular 1184 (revised annually) November, 1985

Issued in furtherance of Cooperative Extension Work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. WILLIAM R. OSCHWALD, *Director,* Cooperative Extension Service, University of Illinois at Urbana-Champaign. The Illinois Cooperative Extension Service provides equal opportunities in programs and employment.

4.5M—11-85—62689—ct

LIMITATIONS ON DAYS BETWEEN APPLICATION AND HARVEST AND OTHER RESTRICTIONS WHEN USING FUNGICIDES ON VEGETABLES IN ILLINOIS

Crop	Benlate[a]	Captan (D)	Bravo	Di-folatan	Dyrene	maneb[b]	mancozeb[c]	Phaltan	zineb
Asparagus	..	root dip	..	..	..	A	A	..	A
Beans (dry, lima, snap)	14, 28 on lima, B	pp, 0	7, B (snap only)	..	..	0, 4 on limas or snap	..	..	7
Beet, garden	..	0, pp	..	..	..	..	..	..	7
Broccoli	..	pp	0	..	..	7, or trim and wash, 3	..	..	7
Brussels sprouts	..	pp	0	..	..	7	..	..	7
Cabbage	..	pp	0	..	..	7	..	..	7
Cantaloupe (muskmelon and honeydew melon)	0	0, ph, pp	0	0	0	5	5	0	5
Carrot	4	0	0	..	..	0	7, B (tops)	..	7 (tops)
Cauliflower	..	pp	0	..	..	7	..	..	7
Celery	7	0, pb	7	..	0	14, strip and wash	14	7	14
Chinese cabbage	..	..	..	..	..	..	..	..	7
Corn, sweet and pop	..	10, B, pp	14, B[d]	..	..	0, B, C	7, B	..	0, B, C
Cucumber	0	0, ph, pp	0	0	0	5	7	0	5
Eggplant	..	0, ph, pb	..	..	..	0	..	..	0
Endive, escarole	..	..	..	..	..	10, and wash	..	..	10
Fennel	..	..	..	..	..	..	7	..	..
Kale, collard	..	pp	..	..	..	10, and wash	..	..	7, collard 10,kale
Kohlrabi	..	pp	..	..	..	7	..	..	halfgrown
Leek	..	..	..	..	0	..	..	0	..
Lettuce	..	0	..	..	..	10, strip and wash	..	0	10
Mustard greens	..	pp	..	..	..	10, and wash	..	..	10
Onion	..	0, ph	green, 14; dry, 7	0	0	0	7, D	0	7
Parsley	..	..	..	..	..	..	..	..	..
Parsnip	..	..	..	..	..	..	..	..	..
Peas	..	pp	..	..	..	..	..	..	10
Pepper	..	0, pb, pp	..	..	..	0	..	..	0
Potato, Irish	..	0, ph	0	0	0	0, C	0	..	0 and seed, C, pp
Pumpkin	0	0, pp	0	..	0	5	..	0	0
Radish	..	..	..	..	..	..	..	..	0
Rhubarb (greenhouse)	..	0	..	..	..	0	..	..	..
Shallots	..	..	..	..	0	..	..	0	..
Spinach	..	0, pp	..	..	..	10, and wash	..	..	10
Squash	0	0, pp	0	..	0	5	5	0	5
Sugar beet	21	0	..	..	..	14, B, C	14, B	..	..
Swiss chard	..	0	..	..	..	..	..	..	10
Tomato	0	0, pp	0	0[e]	0	5, F	5	0	5
Turnip, rutabaga	..	pp	..	..	..	7, and wash	..	..	7 (tops)
Watermelon	0	0, pp	0	0	0	5	5	0	5

NOTE: Numbers in the table indicate number of days between last application and harvest; 0 = up to harvest. Dots in a column indicate that the fungicide is not registered for use on that particular vegetable. Other abbreviations used in the table are as follows:

A = Postharvest application to ferns only or to young plantings that will not be harvested.
B = Do not feed treated tops or forage to livestock.
C = Do not use treated seed or seed pieces for feed or food.
D = Do not apply to exposed bulbs.
E = Do not apply after fruit buds form.
F = To avoid damage, do not use on tender young plants.
pb = Plant bed treatment.
ph = Postharvest spray or dip.
pp = Preplant soil treatment.

[a] Do not apply Benlate alone; always use in combination with mancozeb or other labelled protective fungicide such as Captan, Bravo, Dyrene, or maneb. Do not mix with Mertect or Topsin-M.
[b] Maneb is sold as Manex, Maneb 80, Dithane M22, and Manzate. Maneb with zinc salt is sold as Dithane M22 Special, Manzate D, Dithane Flowable, and Manzate Flowable Fungicide.
[c] Mancozeb is sold as Dithane M-45 and Manzate 200.
[d] Do not apply if the crop will be used for processing.
[e] Machine harvest only.

LABEL INFORMATION ON FUNGICIDES OF LESS GENERAL USE

Fungicide (tolerance)	Crops and use restrictions
Botran	**Beans** (snap) — white mold, 2 days to harvest. Do not feed forage to livestock. **Greenhouse tomato** — to harvest. Do not drench seedlings or newly set transplants. **Carrot** — postharvest dip or spray, see label. **Garlic, onion** — soil application before seeding or spray to soil around sets or bulbs. *Do not plant spinach* as a followup crop in treated soil. **Leaf lettuce** (greenhouse) — 14 days[a] (do not apply to wilted plants or seedlings). **Head lettuce** — 14 days. **Celery** — 7 days. **Cucumber** (greenhouse) — see label. **Rhubarb** (greenhouse) — 3 days. **Potato** — 14 days (do *not* feed to livestock). **Sweet potato** — root dip and plant bed treatment. **Note:** Do not plant tomatoes as followup in treated soil. Don't use spent roots for food or feed. Postharvest spray or dip as directed. **Tomato** (greenhouse) — 3 days.
carbofuran (Furadan 10G)	**Corn** (sweet and pop) — nematodes. Apply in band or furrow at planting. **Cucumber, melon, squash, pumpkin** — apply in band at planting.
chloroneb (Demosan)	**Beans** — seedling diseases. Seed treatment or in-furrow spray at planting.
Copper fungicides[b]	**Bean, beet, broccoli, Brussels sprouts, cabbage, cantaloupe, carrot, cauliflower, celery, cucumber, eggplant, honeydew melon, lettuce, muskmelon, onion, pea, potato, pumpkin, radish, spinach, squash, tomato, watermelon.**
tribasic copper sulfate (many trade names)	
copper sulfate (many)	**Bean, broccoli, cabbage, cantaloupe, cassaba melon, cauliflower, celery, cucumber, honeydew melon, muskmelon, Persian melon, potato, pumpkin, radish, squash, tomato, watermelon.**
copper resinate (Citcop 4E, Cop-O-Cide, Emulsifiable Liquid Copper Fungicide)	**Bean, broccoli, cantaloupe, cauliflower, chinese cabbage, carrot, celery, cucumber, honeydew melon, lettuce, muskmelon, onion, pepper, pumpkin, squash, tomato, turnip, watermelon.**
copper ammonium carbonate (Copper-Count N)	**Bean, cabbage, carrot, crenshaw melon, celery, cantaloupe, cassaba melon, cucumber, honeydew melon, lettuce, muskmelon, pepper, Persian melon, potato, squash, tomato, watermelon.**
copper hydroxide (Kocide 101 and 404)	**Bean, broccoli, Brussels sprouts, cabbage, cantaloupe, carrot, celery, cucumber, honeydew melon, muskmelon, pepper, potato, pumpkin, squash, tomato, watermelon.**
copper oxychloride sulfate (COCS, Copro 50 and 53)	**Bean, beet, broccoli, Brussels sprouts, cabbage, cantaloupe, carrot, cassaba melon, cauliflower, celery, crenshaw melon, cucumber, eggplant, honeydew melon, lettuce, muskmelon, onion, pea, Persian melon, potato, pumpkin, spinach, squash, tomato, watermelon.**
Bordeaux mixture (many trade names)	**Asparagus, beans, beets, broccoli, Brussels sprouts, cabbage, carrot, cassaba melon, celery, collards, crenshaw melon, honeydew melon, horseradish, kale, mustard, pepper, rape, rutabaga, spinach, cress, cucumber, eggplant, honeydew melon, muskmelon, Persian melon, potato, pumpkin, radish, squash, tomato, turnip, watermelon.**
dinocap (Karathane)	**Cantaloupe (muskmelon), cucumber, honeydew melon, pumpkin, squash, watermelon** — 7 days. For control of powdery mildew only.
etridiazol (Terrazole, Truban)	Seed treatment: **Beans, peas, sugar beets.**
Iprodione (Rovral)	**Head lettuce** — lettuce drop and bottom rot, no more than 3 treatments. **Garlic** — white rot. Root crops, cereal grains, soybeans, and tomatoes may be planted the next year. Garlic and leafy vegetables may be planted following treated lettuce.
metalaxyl (Apron 2E)	Seed treatment for control of Pythium and Phytophthora root rot on **sweet corn, popcorn, peas, snap and dry beans.**
(Ridomil 2E)	**Tomatoes, cucumbers, melons, squash** — Pythium damping off. Apply 2-4 tablespoons in 2 gal water per 150 square feet before or at the time of seeding. Follow with ½ inch water to incorporate.
(Ridomil MZ58)	**Cucumber, melon** — 5 days, no more than 20 lb/A/yr. **Onion** — 7 days, no more than 12.5 lb/A/yr. **Potato** — 7 days, no more than 22.5 lb/A/yr. **Tomato** — 5 days. Use only where downy mildew or late blight disease problems exist. Corn, root crops, or the aforementioned crops may be planted the year following use; other crops may not be planted until 18 months after treatment.
metiram (Polyram)	**Potato, sugar beet** — no time limitations. **Celery** — 14 days. **Cantaloupe, cucumber, tomato** — 5 days. Do *not* feed **sugar beet** tops to meat or dairy animals. **Celery** — strip, trim, and wash — 14 days. Postharvest application to **asparagus ferns. Corn** — fresh market only.
oxymal (Vydate)	**Potatoes** — nematodes. Apply before or at planting.
PCNB (Terraclor, Brassicol, Fungiclor)	**Beans** — base of plants *before* blossoming, soil and seed treatment at planting, or foliar spray. Do *not* feed treated **Bean** vines to livestock. Do *not* apply after first bloom. **Broccoli, Brussels sprouts, cabbage, cauliflower** — transplant solution (¾ pint per plant) or row treatment before transplanting. **Pepper, potato, tomato** — soil treatment at or before planting. **Tomato** (greenhouse) — transplant solution (½ pt. of 0.2% per plant). **Garlic** — soil and seed treatment at planting.
streptomycin	**Celery, pepper, tomato** — plant beds only (200 ppm spray); **Potato** — seedpiece treatment only (100 ppm dip or dust). Soak cut seed pieces less than 30 min. **Beans** — seed treatment for halo blight control. Do not use treated seed for food or feed.
sulfur, lime, and lime-sulfur	Exempt when used with good agricultural practices. See label.
terbufos (Counter 15G)	**Corn** (sweet and pop) — Apply in band or furrow at planting.
thiabendazole (Mertect)	**Sweet potato** — "seed" root treatment. Do not use treated pieces for food or feed. **Potato** — "seed" tubers only (1,500 ppm-20 sec. dip). Storage rot control.
thiophanate methyl (Topsin-M)	**Beans** — white mold and gray mold. Snap or dry beans, 14 days. Lima, 28 days. **Celery** — early and late blight, 7 days, limit of 4 applications per year.
(TOPS 2.5D)	**Potato** — seed piece treatment.
thiram, TMTD	**Onion** — Furrow treatment. **Celery** — 7 days (strip, trim, and wash). **Sweet potato** — preplant root dip. **Tomato** — 0 days, for leaf spots and fruit rots. Seed treatment: **Beans, beets, broccoli, Brussels sprouts, cabbage, cantaloupe, carrot, cauliflower, collard, corn, cucumber, eggplant, endive, kale, kohlrabi, lettuce, okra, onion** (bulb, seed, and set), **peas, pepper, pumpkin, radish, spinach, squash, Swiss chard, tomato, turnip, watermelon.** WARNING: Do not use treated seed for food, feed, or oil — 7 days.
triadimefon (Bayleton)	**Cantaloupe (muskmelon), cucumber, honeydew melon, pumpkin, squash, watermelon** — powdery mildew. May apply a maximum of 1 lb./A/yr. of 50% wp.
triphenyltin (Du-Ter)	**Carrot** — Alternaria leaf spot and late blight — 14 days. **Potato** — early and late blight. May be applied through irrigation systems (solid set or center pivot only).
vinclozolin	**Head lettuce** only. Sclerotinia drop (Ronalin). No more than 3 treatments. Limit of 28 days to harvest.
ziram	**Cucumber, melon** — 0 days. **Beans** (snap and lima) — 4 days. **Tomato** — 7 days.

[a] Number of days between last application and harvest.

[b] There are many other copper materials, but these are most widely available and labeled for use on vegetable crops. Exempt from tolerance if used with good agricultural practices; not exempt if used at the time of harvest or after harvest. See label.

CONDENSED RECOMMENDATIONS ON DISEASE MANAGEMENT FOR DISEASES OF COMMERCIAL VEGETABLE CROPS FOR 1986

Vegetable	Disease management practices
Asparagus	
Crown or root rots, Seedling blights, and wilt	No resistant varieties are available for control of these diseases. Treating the crowns with captan or mancozeb may aid in control. These diseases are best managed by good asparagus culture. Provide optimal soil fertility, and weed, insect and rust control. Avoid excessive cutting.
Rust, other leaf and branchlet blights	Grow rust-resistant varieties. Apply zineb, maneb, mancozeb, or Polyram to nonharvested fields up to August 15 and to harvested fields after harvest only. Applications should be made on 7- to 10-day intervals.
Beans (snap, dry, wax, and lima)	
Most diseases	When possible, use rotations of 2-3 years between bean crops.
Seed decay, damping-off, seed-borne stem blights, and root rots	Plant only western-grown, certified seed in a seed bed that is warm (60°-65° F.) and well-prepared. Seed treatment with metalaxyl, thiram, captan, captan plus fenaminosulf, Terrazole, or chloroneb plus insecticide is suggested. In-furrow sprays of chloroneb or seed treatment with metalaxyl may be helpful for early season root-rot control.
Root rots	Maintain optimal soil fertility. Utilize crop rotations of 2-3 years.
Bacterial blights	Plant only western-grown, certified seed. Utilize crop rotations of 2 to 3 years. Avoid cultivating when beans are wet. Streptomycin may be added to seed treatment fungicide/insecticide. Field applications of 2-3 pounds of fixed copper per acre will provide good control of brown spot and halo blight, only moderate control of common or fuscous blight.
Downy mildew and syringe blight (brown spot) on lima beans	Make early and weekly applications of maneb plus fixed copper. Eliminate lilac and wild cherry from field borders.
Rust, anthracnose, and other fungal leaf, pod, and stem diseases	Utilize crop rotations of 2-3 years. Apply maneb, zineb, or Bravo at 7- to 10-day intervals. Rust-resistant varieties are available for some types of beans. Sulfur can also be used but may be phytotoxic at high temperatures.
White mold, gray mold	Apply Benlate, Botran, or Topsin-M first at initial to 25 percent bloom and again at full bloom. Botran may be used on snap beans only.
Virus diseases	Plant varieties with resistance to bean common mosaic, NY15 strain of common mosaic, and bean yellow mosaic.
Soybean cyst nematode	Rotate 2-3 years with corn, small grains, alfalfa, red clover, or other nonhost crop. Do not include soybeans in the rotation.
Beets (garden and sugar), Swiss chard	
Seed rot, damping-off, and seed-borne leaf spot	Sow in a well-prepared seed bed. Treat seed with captan or thiram. Make sure boron levels are adequate.
Cercospora leaf spot	Apply zineb or fixed copper weekly at the first sign of disease.
Crucifer crops (broccoli, Brussels sprouts, cauliflower, cabbage, chinese cabbage, collards, kale, kohlrabi, mustard, radish, rutabaga)	
Seed rot, damping-off, black rot, blackleg	Sow only western-grown, hot water-treated seed. Seed also should be treated with thiram or captan. Place seed beds where no crucifer has grown for 4 years or more and where water will not drain from fields recently planted to crucifers.
Wirestem (*Rhizoctonia*)	Incorporate PCNB-captan in upper 3 inches of soil before planting or drench after planting.
Clubroot	Apply PCNB (Terraclor 75) in transplant water.
Black rot and blackleg	Use a crop rotation of 3-4 years or more. Use only hot water-treated seed. Use care in the selection of plant bed sites. Be sure no drainage occurs to seed bed from old plantings. Control wild mustard and other cruciferous weeds. Purchase only certified, disease-free transplants. Do not dip transplants before planting. Sprays of fixed copper may help control black rot. Bravo applied to control downy mildew may also help control blackleg. Some cabbage varieties resistant to black rot are available. Losses are generally lower where direct seeding is used.
Downy mildew, Alternaria leaf spot, and other fungal leaf diseases	Apply maneb, zineb, or Bravo on weekly intervals. Start applications in seed bed or when plants are young.
Tipburn	Plant resistant varieties.
Fusarium yellows	Plant yellows-resistant varieties.
Radish black root	Plant resistant varieties.
Carrots, Parsnips	
Seed rot, damping-off	Treat seed with captan or thiram.
Cercospora leaf spot, Alternaria leaf blight	Apply maneb, mancozeb, zineb, or Bravo on 7-10 day interval.
Aster yellows	Use insecticides to control leafhoppers that transmit the mycoplasma. Excellent early season leafhopper control is essential. Control must occur *before* leafhoppers feed.
Root-knot nematode	Fumigate mineral soils with D-D, Telone, or Vorlex, *or* practice a 3-year rotation with corn or some other nonhost crop with which broadleaf weed hosts will be controlled.
Parsnip canker	Spray with fixed copper at a 10-day interval in late season (August) until the tops die. Ridge soil over the shoulders.

CONDENSED RECOMMENDATIONS ON DISEASE MANAGEMENT (continued)

Vegetable	Disease management practices
Celery, Parsley	
Seed rot, damping-off, seed-borne leaf blights	Treat plant seed with hot water, then captan or thiram. If damping-off starts, spray 2-3 times, 5-7 days apart with zineb. Seed 2-3 years old is free of late blight.
Leaf blights and spots (celery only)	Spray maneb, zineb, Benlate, Topsin-M, Dyrene, Bravo, or mancozeb at 7-10 day intervals.
Aster yellows and Root-knot nematode	(See the section on Carrots and Parsnips)
Corn (sweet and pop)	
Seed rot, seedling blights, seed-borne diseases	Plant seed treated with captan, thiram, metalaxyl plus captan, or Vitavax-thiram and insecticide.
Goss' bacterial wilt	Use 2 to 3 year crop rotations when using susceptible corn (dent or sweet) varieties.
Stewart's disease	Control flea beetles with insecticide, or plant tolerant hybrids.
Smut	Plant tolerant hybrids.
Maize dwarf mosaic, Wheat streak mosaic	Control Johnsongrass and volunteer wheat. Plant wheat after the fly-free date. Some hybrids tolerate maize dwarf better than others, but no hybrids are highly resistant.
Helminthosporium leaf blights, anthracnose leaf blight	Spray mancozeb, zineb, maneb, Polyram, or Bravo when disease first appears. Crop rotation and clean tillage will help reduce disease risk.
Rust	Spray the same as for Helminthosporium blights or plant resistant varieties.
Nematodes	Apply carbofuran or terbufos at the time of planting.
Vine Crops (cucumbers, muskmelons (cantaloupe), pumpkins, squash, and watermelons)	
General	Use a crop rotation of 3-4 years. Grow resistant varieties whenever possible.
Seed rot, damping-off, seed-borne diseases	Plant only certified, western-grown seed treated with captan or thiram. Damping-off can be treated with a captan or Ridomil bed drench.
Bacterial wilt	Provide season-long control of striped and spotted cucumber beetles. Start as the plants emerge. Planting-time treatment with Furadan will provide moderate control for 3-4 weeks. Supplemental insecticide use will be necessary.
Anthracnose, scab, blossom blights, gummy stem blight, or black rot	Grow resistant varieties whenever possible. Spray weekly with maneb, zineb, Bravo, Dyrene, Difolatan, or Benlate.
Downy mildew, Alternaria leaf blight	Grow resistant varieties whenever possible. Maintain ample but *not* excessive nitrogen fertility. Apply maneb, zineb, mancozeb, Dyrene, Bravo, or Difolatan on a weekly schedule.
Fruit spots and rots	Maintain fungicide schedule as for anthracnose through the season. Avoid harvest injuries.
Fusarium wilt	Grow resistant varieties.
Angular leaf spot	Apply fixed copper sprays in combination with zineb, maneb, or mancozeb. Start applications early in the season. Practice crop rotations of 3-4 years. Resistant cucumber varieties are available.
Powdery mildew	Apply Bayleton or Karathane WD at the first sign of disease and again 10 days later for Karathane (10-14 days later for Bayleton). Where Benlate or Bravo is applied to control other diseases, mildew will be controlled well. Plant resistant varieties where possible.
Mosaics	Control aphids and beetles in the field. Control broadleaf weeds around field borders. Plant only mosaic-resistant cucumbers.
Root-knot nematode	Fumigate with Vapam or Vorlex in the fall before planting or use Furadan at planting.
Eggplant	
Seed rot, damping-off, seed-borne diseases	Plant hot water-treated seed when possible. Treat the seed with captan or thiram. Damping-off can be controlled with a captan drench.
Phomopsis blight, Alternaria leaf spot, Cercospora leaf spot, and anthracnose	Spray plants weekly with maneb, zineb, or captan at first sign of disease or when first fruits are half sized.
Verticillium wilt, nematodes	Fumigate the soil with Vapam, Vorlex, or methyl bromide plus chloropicrin. Planting in black plastic mulch will help reduce disease severity.
Horseradish	
Leaf spots	Apply fixed-copper fungicides. Start when conditions are wet or dews are heavy. Continue until a killing frost occurs.
Brittleroot	Plant clean sets. Control leafhoppers.
Verticillium wilt	Fumigate the soil before planting with Telone C.
Lettuce, Endive	
Seed rot, damping-off, Gray mold	Treat seed with captan. In the field or seed bed, work Botran into the soil before planting and spray Botran after thinning or transplanting and again as necessary. Ferbam or zineb can be used as drenches to control damping-off.
Aster yellows	Control leafhoppers throughout the season. Early season control is most important.
Rhizoctonia bottom rot, Sclerotinia drop	Plant on beds and deep plow when possible. Apply Rovral at 3-leaf stage and again 10 days later. A third application may be made 10 days later if disease conditions warrant. Botran applications as previously described may help. Ronalin should be applied 2 days after thinning, 14 days later, and 14 days after the second spray. Use 100 gallons of water carrier per acre.
Gray mold, white rust, downy mildew	Apply ferbam, maneb, or zineb at 5- to 7-day intervals.

CONDENSED RECOMMENDATIONS ON DISEASE MANAGEMENT (continued)

Vegetable	Disease management practices
Okra	
Seed rot, damping-off	Treat seed with captan or thiram.
Fusarium wilt or Verticillium wilt	Fumigate soil with Vorlex, Vapam, or methyl bromide plus chloropicrin.
Onions, garlic, leek, chives	
Smut, seed rot, damping-off	Treat the seed with captan or thiram. Use Methocel sticker to pellet the fungicide with seed. Use 1 pound of active ingredient to 20 pounds of seed for set onions; 6 pounds of active ingredient to 8 pounds of seed for bulb onions.
Blast, downy mildew, Alternaria purple blotch, Botrytis neck rot	Apply maneb, zineb, mancozeb, Difolatan, Dyrene, Phaltan, or Bravo on a weekly schedule. Begin spraying with first ozone alert. Continue until harvest. Bravo has given superior control in research trials.
Bulb and stem nematode, Root-knot nematode	Fumigate with Telone or DD.
White rot of garlic	Apply Rovral on cloves and furrow covering soil.
Fusarium basal rot	Avoid heavily infested fields. Grow resistant varieties.
Storage decays	Maintain excellent control of leaf diseases in the field. Maintain dry storage conditions.
Yellow dwarf mosaic	Control aphids. Keep old and new plantings as far apart as possible.
Peas	
Seed rot, seedling and seed-borne diseases	Plant western-grown seed treated with captan, thiram, or zineb plus insecticide. Graphite at 1 ounce per bushel may be added to reduce friction in the drill.
Root rot	Index production fields. Avoid planting in fields with an index of 75 or higher. In fields with a lower root rot index, dinoseb (Premerge 3) or trifluralin applied preplant incorporated will provide good to excellent control.
Fusarium wilt, near wilt, and virus diseases	Grow resistant varieties.
Powdery mildew	Apply lime-sulfur dust (4:6 ratio) at 30 pounds per acre when mildew first appears and temperatures are less than 80° F. Two applications a week apart will provide good control.
Fungal leaf spots and blights	Apply zineb weekly when necessary.
Peppers	
Seed rot, damping-off, and seed-borne diseases	Treat seed with hot water or a sodium hypochlorite (household bleach) soak, then use captan or thiram. The sodium hypochlorite soak will control seedborne bacterial spot. Use 1 part bleach to 3 parts water, soak 1 to 2 minutes. Use 1 gallon of bleach-water solution to 1 pound of seed. Rinse thoroughly before treating with fungicide.
Bacterial spot	Use crop rotations of 2-3 years, excluding small grains and tomatoes. Control broadleaf weeds in field borders. Apply copper plus streptomycin to seedlings. After transplanting, apply fixed copper plus maneb or mancozeb, on a 5- to 7-day interval. Purchase only certified, disease-free transplants. Planting peppers in narrow strips between early planted corn may help reduce spread during severe rain and wind storms.
Anthracnose, Cercospora leaf spot, other fungal leaf spots, and fruit rots	Apply maneb or zineb after first fruits form on a 5- to 7-day interval.
Verticillium wilt	Fumigate soil with Vapam, Vorlex, or methyl bromide plus chloropicrin.
Virus diseases	Grow resistant varieties. Control aphids and broadleaf weeds in and around fields. Plant only healthy transplants.
Potatoes (Irish)	
General	Purchase only certified seed. Seed-production fields should be inspected for virus, nematode, or fungal disease problems.
Seedpiece decay, seed-borne diseases, Verticillium wilt, and Blackleg	Treat seed with captan, maneb, mancozeb, or with TOPS 2.5D (Topsin plus Douglas fir bark). Keep seed storage at approximately 40° F. during the winter. In the spring, warm the seed to 60°-70° F. for 1.5-2 weeks before cutting. Streptomycin may be added to fungicide dusts to improve the control of bacterial diseases. Avoid bruising seed during handling.
Scab	Plant resistant varieties. Do *not* apply manure or other organic matter immediately before the potato crop. Working PCNB into the top 4-6 inches of the soil at or before planting may help.
Storage rots	Store healthy, sound, unbruised potatoes. Maintain a proper storage environment. Apply Mertect 340F as a spray to unwashed tubers before storage. This will help control Fusarium dry rot.
Rhizoctonia	Use a Terraclor EC soil treatment.
Verticillium wilt	Practice crop rotation, use only seed free of Verticillium. Control root-knot and root-lesion nematodes. Soil fumigation with Vapam or Vorlex may be practical.
Nematodes	Where soil samples indicate damaging levels of nematodes, apply Temik or Vydate, or fumigate with Vapam, Vorlex, D-D, or Telone C.
Early blight and late blight	Apply maneb, mancozeb, Difolatan, Bravo, Polyram, Du-Ter, or Dyrene on 7- to 10-day schedule. Maintain an adequate supply of nitrogen throughout the season to provide good control of early blight. Use Ridomil MZ58 only where late blight infection is present.
Virus diseases and Purple-top wilt (Aster yellows)	Plant certified seed only. Control aphids and leafhoppers with insecticides.
Rhubarb (greenhouse only)	
Botrytis leaf rot	Apply maneb or copper after budding and at weekly intervals until harvest.

CONDENSED RECOMMENDATIONS ON DISEASE MANAGEMENT (concluded)

Vegetable	Disease management practices
Crown and root rots	Plant only in well-drained soil. Maintain optimal soil fertility. Drench the crowns with fixed copper at 3 pounds per acre in the early spring and after harvest if crown rot is a problem.
Spinach	
Seed rot and damping-off	Treat seed with captan or thiram.
Downy mildew or blue mold, White rust, anthracnose, and other fungal leaf diseases	Grow resistant varieties or spray with captan, maneb, or zineb on a 5- to 7-day schedule starting before the plants begin to rosette.
Cucumber mosaic virus or blight	Grow resistant varieties.
Sweet potatoes	
Black rot, foot rot, Fusarium wilt and scurf	Grow resistant varieties. Plant disease-free roots and use crop rotations of 3-4 years. Dip the roots or sprouts in Botran or Mertect 340F.
Storage rots	Fumigate storage crates and houses with formaldehyde. Use Botran as a postharvest dip. Store only healthy, blemish-free roots.
Nematodes	Plant resistant varieties. Use crop rotation. Temik, Mocap, or Dasanit may be used for chemical control.
Tomatoes (field)	
Seed decay, damping-off, and seed-borne diseases	Plant hot-water- or sodium-hypochlorite-soaked seed that has been treated with captan or thiram. See treatment for pepper seed. Use Ridomil bed drench for Pythium damping off.
Bacterial spot and bacterial speck	Purchase certified, disease-free plants. Use crop rotations of 2-3 years, excluding small grains. In the seed bed, spray with fixed copper plus streptomycin. After transplanting, spray with fixed copper plus mancozeb. Once established, bacterial spot is difficult to control.
Septoria blight, early blight, buckeye rot, gray leaf spot, and leaf mold	Apply maneb, mancozeb, Polyram, zineb, Dyrene, Bravo, or Difolatan on a 7- to 10-day schedule after the first sign of disease or after the first fruits form. Difolatan may be used only on machine-harvested fruit. A soil surface spray of Difolatan or maneb after the last cultivation will improve anthracnose control. Benlate may be used for Botrytis and Septoria control.
Blossom-end rot	Mulch plants or maintain uniform soil moisture. Applications of calcium nitrate starting when the fruits are grape size may reduce losses.
Verticillium wilt and Fusarium wilt	Grow resistant varieties.
Viruses	Take care to avoid infesting the seedlings. Start with virus-free seed. Control insects and broad leaf weeds in and around fields. See greenhouse tomatoes below.
Tomatoes (greenhouse)	
Virus diseases	Start with hot water-treated seed. Do not allow the use of tobacco on the premises. Smokers should wash their hands with soap and hot water before working with plants. If possible, plant TMV-resistant hybrids. Control insects. Remove infected plants if possible.
Botrytis gray mold, leaf mold, and gray leaf spot	Avoid excessive humidity by heating and venting, especially at night during the late fall, early winter, and early spring. Spray weekly with Benlate, mancozeb, or Bravo *or* fumigate with Exotherm Termil.
Nematodes, root rots, and soil-borne TMV	Steam the plant beds.

GENERAL SUGGESTIONS ON FUNGICIDE APPLICATION

1. Cover the foliage uniformly. *Ground equipment* — Apply 75 to 125 gallons per acre at approximately 400 pounds per square inch of pressure. Lowering volumes and/or pressures may provide adequate coverage, but high-volume, high-pressure applications provide ideal coverage. Make sure the sprayer is functioning properly. Check the nozzles for cleanliness and wear. Boom, height, accuracy of pressure gauge, agitation, and calibration should also be checked. *Aerial application* — Apply recommended amounts of pesticide per acre in 3 to 5 gallons of water. Make sure nozzles are properly aligned and clean, so uniform application is achieved. Cover a swath no wider than is reasonable for the aircraft and boom being used. Spray only those fields which are suitable for aerial application. Avoid fields of irregular shape or topography, particularly if they are bounded by power lines, trees, or other obstructions.

2. Whenever possible spray when the air is still or when wind velocity is not excessive (less than 10 to 12 mph).

3. Avoid situations where pesticide drift may cause needless problems.

4. When it is compatible with the product label, use a spray adjuvant (surfactant). Some commonly available surfactants are: Colloidal Products X77 (liquid, non-ionic) spreader activator; Colloidal Products Multifilm L. (liquid); Colloidal Products Spray Modifier (liquid, non-ionic) spreader sticker; Millers Nufilm 17 liquid spreader sticker; Millers Nufilm P liquid spreader sticker; Allied Chemical Plyac (liquid) sticker; Rohm and Haas Triton B — 1956 (liquid, non-ionic) spreader sticker; Triton CS7, spreader-binder; and Du Pont Spreader Sticker (liquid) spreader sticker.

GENERAL SUGGESTIONS ON SOIL FUMIGATION

Follow the manufacturer's directions exactly. Fumigants work best in light, loose soils that are free of trash, clods, and lumps. Avoid recontaminating treated soil. It is best to apply fumigants during the fall before planting. In general, the soil temperature must be at least 55° F. at the 6-inch depth, with a time lapse of 21-28 days between treating and seeding. Some require gas-tight plastic covers.

RECORD SHEET FOR FUNGICIDE USERS

Date	Vegetable	Chemical	Dosage per acre	Remarks